Space Weather Technical Forecast

Issued on Thursday, 08 February 2024 at 13:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Moderate activity expected Day 1 (08 Feb) then likely Days 2-4 (09-11 Feb) with isolated M-class flares/R1-R2 Radio Blackouts. Chance of isolated X-class flares/R3 Radio Blackouts, mainly Day 1 (08 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with isolated M-flares, the peak flare a M1.3 at 07/1805 UTC from the AR3575. There are currently nine numbered and three unnumbered sunspot regions on the visible disc, however the majority of these are small and relatively stable. AR3576 remains a large and magnetically very complex region in the southeast, with a classification of Fkc/Beta-Gamma-Delta. Magnetic looping is evident in SDO imagery between this region, and several other regions on the southeast disc in close proximity to AR3576. However, it is AR3575, a smaller but still complex region, that has been responsible for the M-flares over the past 24 hours. The viewing angle and position of this region, as it transits across the southwest limb, prevents accurate analysis. Therefore, the previous classification of Dkc/Beta-Gamma-Delta is maintained.

No Earth-directed CMEs were observed on available imagery during the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1 have predominantly remained at slightly elevated levels, with occasional periods of elevated wind speeds. Winds are currently around 480-500 km/s, peaking at 549 km/s at 07/2114 UTC. Density has remained below average. The Interplanetary Magnetic field (IMF), Bt, was weak, at or below 5nT. The north-south component Bz, has weakly fluctuated between +4nT and -4nT and has been largely southwards oriented since 08/0908 UTC . Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux remained at background levels. GOES16 high energy (greater than 2MeV) electron flux remained at background levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold and has had a flat trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity expected Day 1 (08 Feb), with isolated M-flares and a chance of X-flares. These most likely from two large and complex regions, either AR3576 in the southeast, or from AR3575 in the southwest. The flare risks reduce slightly as AR3575 behind the southwest limb by Day 2 (09 Feb), however new or returning regions maintain a likelihood of Moderate activity Days 2-4 (09-11 Feb).

Solar Wind / Geomagnetic Activity: Wind speeds are expected to remain at predominantly slightly elevate levels Days 1-2 (08-09 Feb) before eventually declining to slow-ambient levels on Day 3 (10 Feb). There is a low probability of connection to a HSS from CH97/+ producing enhancement Days 3-4 (10-11 Feb). A CME that left the Sun in association with the M4.2 flare early 06 Feb may provide a slight glancing blow late Day 2 or early Day 3. Geomagnetic activity is expected to be mostly Quiet (Kp 0-2), with a chance of Unsettled intervals (Kp 3) and a very

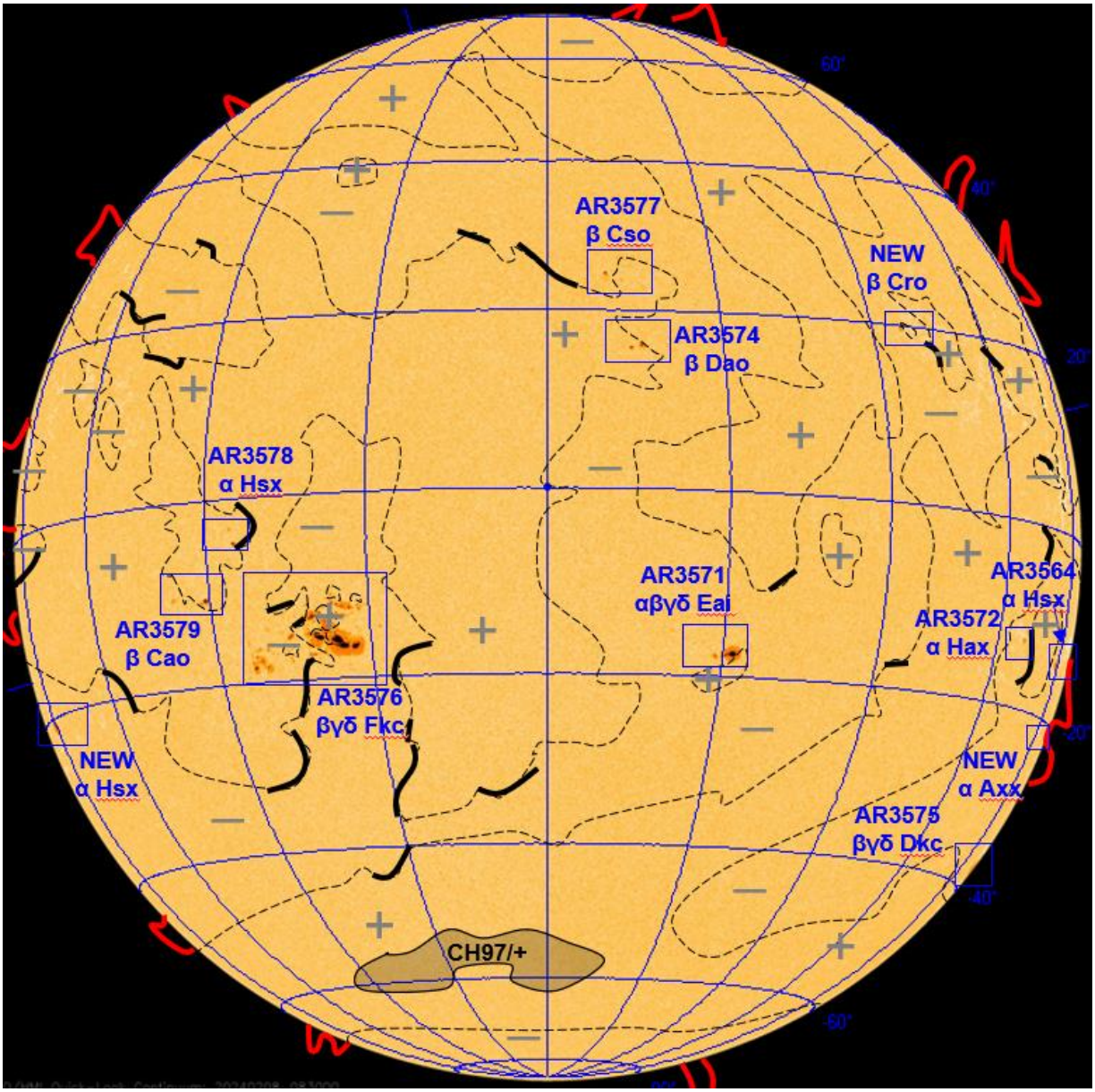
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

slight chance of a G1/Minor Geomagnetic Storm interval (Kp 5), should any CME enhancement occur Days 2-3.

Energetic Particles / Solar Radiation: High energy proton flux has the potential to rise in response to any significant flares, most likely from AR3575 or AR3576. AR3576 will move into a more central location through the period, becoming the main risk region from Day 2 (09 Feb) as AR3575 will have rotated completely beyond the western limb. High energy electron flux (greater than 2MeV) is expected to continue at low to moderate levels, perhaps becoming mostly moderate by the end of the period. The associated 24 hour electron fluence will remain well below the Active threshold, despite a possible very gradual upwards trend.

Figure 1. Solar Analysis Valid 08/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:

Solar winds are currently 480-500 km/s with speeds potentially indicative of slight enhancement from a small coronal hole (CH96/+) which is now no longer visible. A gradual decline in winds is possible over the next 24 hours. A decline to slow-ambient levels is projected through Day 3 (10 Feb), as supported by both Enlil and SWPM. SWPM is considered to be giving good guidance at this point. Some Enlil ensemble members indicate that a new weak HSS may arrive through Day 3, likely associated with CH97/+ in the southern disc. Any enhancement and geomagnetic effects associated with this low HSS are considered to be minor, with speeds remaining at, or close to, slow-ambient levels.

A CME that left the Sun in association with the M4.2 flare early on 06 Feb may give a glancing blow late tomorrow Day 2 (09 Feb) or early Day 3, bringing a very slight chance of a G1/Minor Geomagnetic Storm interval, in conjunction with any weak HSS influence. However, a miss is more probable. The CME associated with the M5.1 flare at 07/0330 UTC has been analysed and is expected to miss Earth.

Throughout the period geomagnetic activity is expected to be mostly Quiet (Kp 0-2), although there is a chance of Unsettled (Kp 3) intervals and a very slight chance of a G1/Minor Geomagnetic Storm interval (Kp 5), should any CME enhancement occur Days 2-3.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earthbound CMEs are expected.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOC Enlil and Ensembles, considered to be giving reasonable guidance although wind speeds too slow.

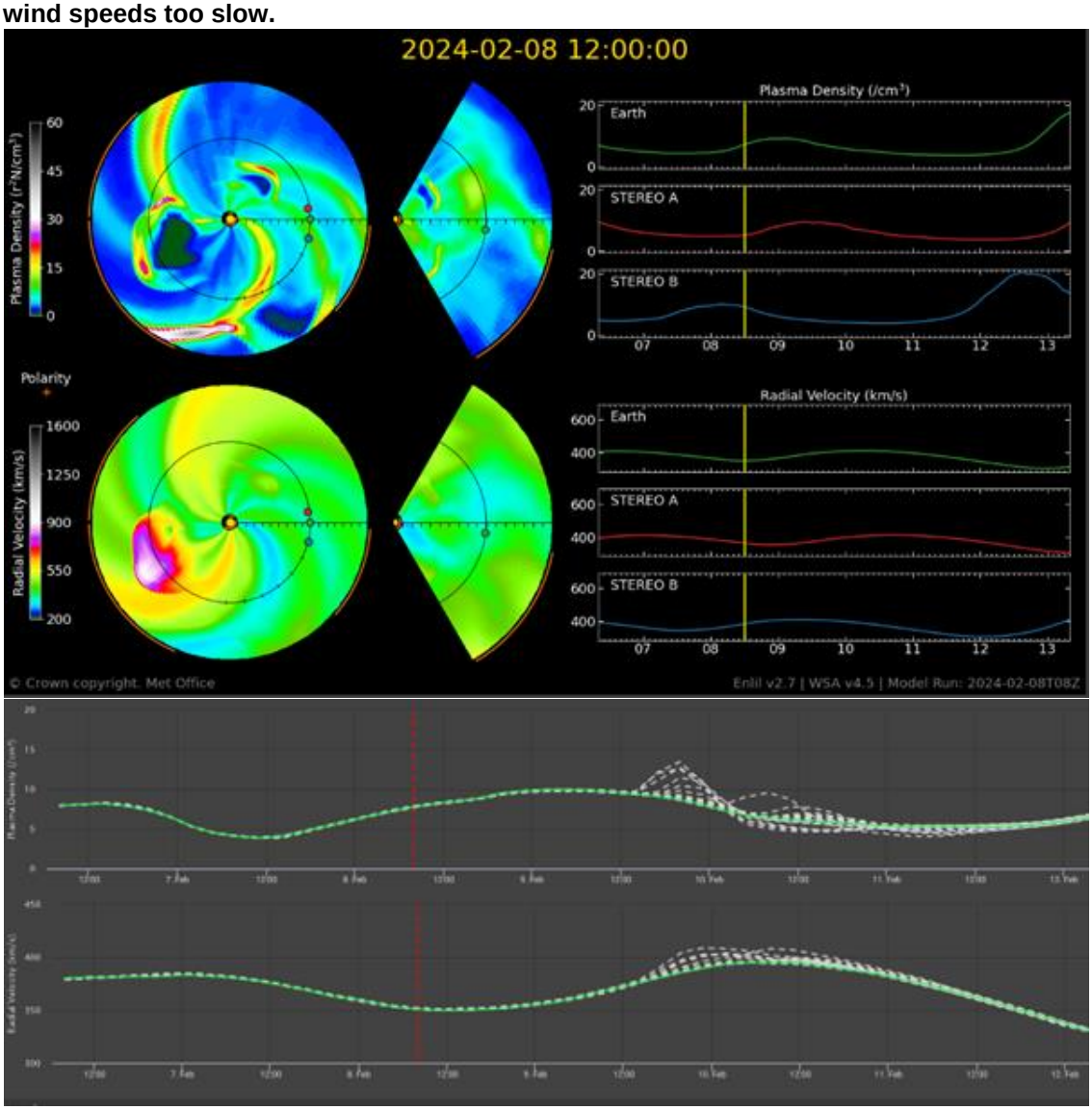
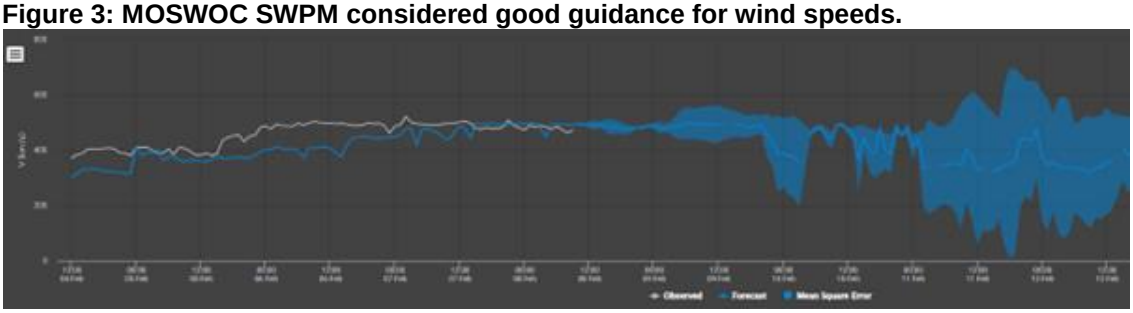


Figure 3: MOSWOC SWPM considered good guidance for wind speeds.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
There are currently nine numbered and three unnumbered regions on the visible disc. AR3576, in the southeast, remains the largest and most significant and complex region with asymmetrical mature penumbra and a number of delta spots, including one sheared delta spot in the central portion of the leading spot. Also evident on SDO-AIA imagery is broad and wide-reaching magnetic looping, connecting the region to others in the vicinity. This region continues to evolve, with the amalgamation of spots in its trailing and northern portions and has produced a C9.7 flare at 08/1146 UTC.

AR3575 (Dkc/Beta-Gamma-Delta) has now almost completely passed beyond the southwest limb, and is expected to depart by Day 2 (09 Feb). This region has primarily been the source for M-class flares over recent days.

AR3574 displays uncertain bipolarity and is currently classified as a Dao/Beta due to the further development of penumbra. Two small new regions have emerged today (08 Feb), a small Axx/Alpha region in the southwest and a rapidly developing but small Cro/Beta region in the northwest. The other regions on the disc are generally much smaller and more magnetically simple.

Moderate activity is expected to persist with isolated M-flares and a chance of X-flares. The probabilities reduce by Day 2 as AR3575 departs. However, new or returning regions are expected to rotate onto the visible disc through the period, maintaining a likelihood of significant flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	60	60	60
Very Active	R3 to R5 X Class	No	20	10	10	10

Figure 4: GOES18 & GOES16 Xray Irradiance Trace over past 24 hours

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
GOES18 high energy (greater than 10MeV) proton flux is currently at background levels. The high energy proton flux has the potential to rise in response to any significant flares, most likely from AR3575 or AR3576. Significant flares from these regions result in a chance of exceeding the S1/Minor Radiation Storm level. The probabilities of this decline to a slight chance from Day 2 (09 Feb) as AR3575 will have completely rotated beyond the western limb. AR3576 will move into a more central location through the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	20	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

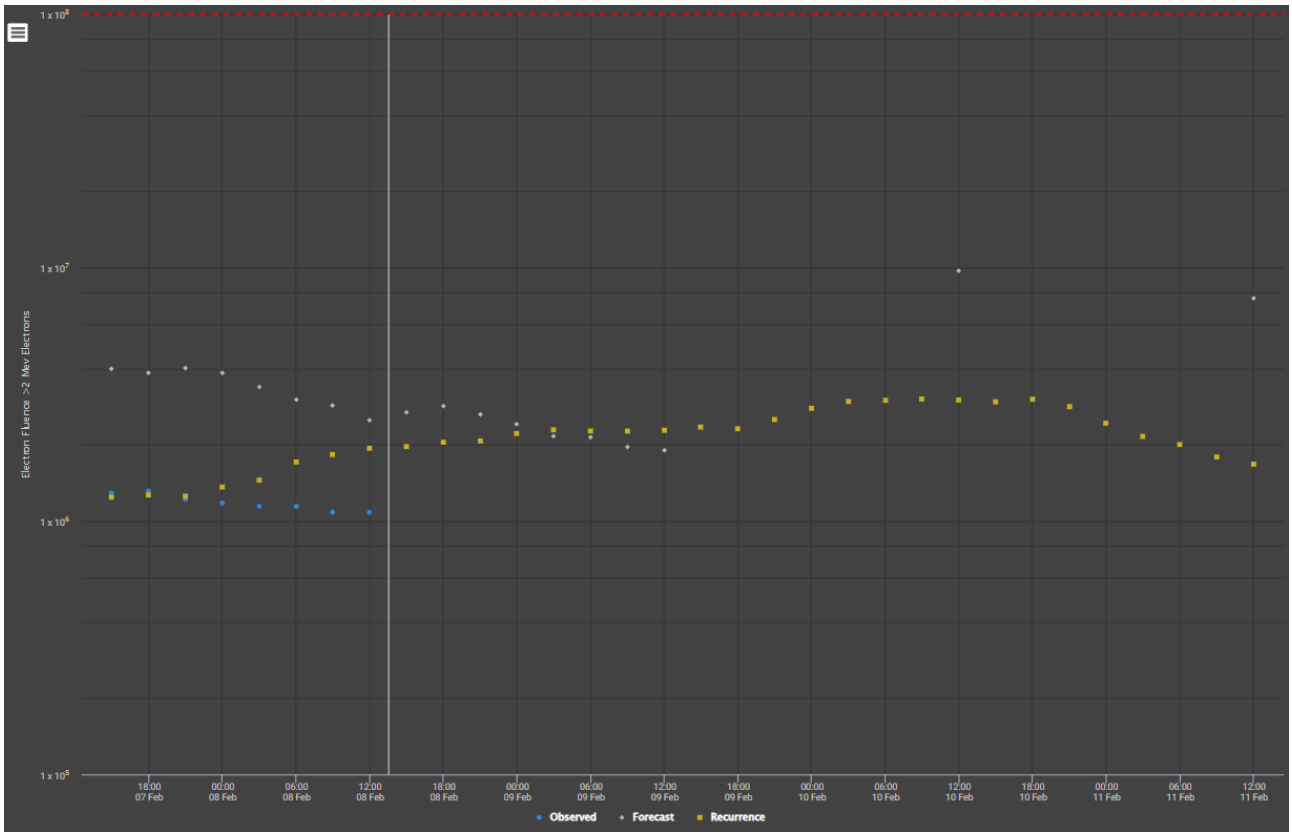
© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES-16 is expected continue at generally low to moderate levels, likely becoming mostly moderate by the end of the period. No appreciable connection to coronal hole high speed streams is expected through the period, with only negligible effects on the electron flux level. Several MOSWOC Enlil ensemble members indicate that a new weak HSS may arrive through Day 3 (10 Feb) but this is considered low likelihood and low confidence.

The associated 24 hour electron fluence is expected to remain well below the Active (1e8 integrated flux) threshold, as suggested by MOSWOC's REFM, which is currently thought to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.